

AMENDMENTS TO THE CLAIMS

1-65. (Canceled)

66. (New) A computerized method for solving a constraint satisfaction problem, comprising:

receiving a set of variables having respective input domains and a set of constraints comprising one or more relations defined as a combination of operators, the combination comprising at least one operator selected from a group of arithmetic and bitwise operators, which are applied to the variables;

building a network of one or more hyper-arcs representing the set of constraints, each hyper-arc corresponding to one of the relations expressed in terms of the operators and linking nodes in the network corresponding to the variables to which the operators are applied; and

reducing the input domains of the variables in the network responsive to the operators, so as to determine respective output domains of the variables that are consistent with the set of constraints.

67. (New) A method according to claim 66, wherein receiving the set of constraints comprises providing a language for specifying the constraints, the language having grammatical rules, and specifying the constraints using the language.

68. (New) A method according to claim 66, wherein reducing the input domains comprises finding projections of the operators onto the domains of the variables.

69. (New) A method according to claim 66, wherein receiving variable and at least one input variable for each of the operators, and

wherein finding the projections comprises projecting the domain of the at least one input variable of each of the operators onto the domain of the output variable thereof, and projecting the domain of the output variable of each of the operators onto the domain of the at least one input variable thereof.

70. (New) A method according to claim 66, wherein the operators comprise multi-variable operators, which receive two or more of the variables as their inputs.

71. (New) A method according to claim 70, wherein the multi-variable operators comprise one or more operators selected from a group consisting of arithmetic addition, arithmetic subtraction, arithmetic multiplication, arithmetic division and modulo operators.

72. (New) A method according to claim 70, wherein the multi-variable operators comprise one or more operators selected from a group consisting of an operator testing arithmetic equality of two of the variables, an operator testing arithmetic inequality of two of the variables, and an operator testing whether one of the variables is greater than another of the variables.

73. (New) A method according to claim 70, wherein the multi-variable operators comprise one or more operators selected from a group consisting of a bitwise “and,” bitwise “or” and bitwise “exclusive or” operations.

74. (New) A method according to claim 66, wherein the combination of operators further comprises at least one logical operator.

75. (New) A method according to claim 74, wherein the at least one logical operator comprises at least one of a disjunction operator, a negation operator, and an implication operator.

76. (New) A method according to claim 66, wherein reducing the input domains comprises, for each of the hyper-arcs, assembling the variables in a hierarchy based on the relation corresponding to the hyper-arc, and reducing the input domains of the variables in the hierarchy.

77. (New) A method according to claim 76, wherein assembling the variables comprises arranging the variables in a hierarchical graph, having vertices corresponding to the variables.

78. (New) A method according to claim 77, wherein arranging the variables in the hierarchical graph comprises arranging the graph so as to have the form of one or more trees.

79. (New) A method according to claim 78, wherein reducing the input domains comprises reducing the input domains over each of the trees so as to find respective interim domains of the variables that are consistent with the relation over each of the

trees, and combining the interim domains over all of the trees to determine the output domains.

80. (New) A method according to claim 77, wherein arranging the variables in the graph comprises inserting vertices in the graph corresponding to the operators, connecting the vertices corresponding to the variables.

81. (New) A method according to claim 66, wherein building the network of the hyper-arcs comprises representing the set of relations as a disjunction of multiple relations, with one of the hyper-arcs corresponding respectively to each of the relations, and

wherein determining the respective output domains comprises determining interim domains of the variables for each of the hyper-arcs, and taking a union of the interim domains for each of the variables to determine the output domains.

82. (New) A method according to claim 66, wherein reducing the input domains comprises determining the output domains such that for any given value in the respective output domain of each of the variables, there exist values of the other variables in the respective output domains thereof that, together with the given value, constitute a solution to the set of relations.

83. (New) A method according to claim 66, wherein reducing the input domains comprises determining the output domains such that every set of values of the variables in the input domains that constitutes a solution to the set of relations is contained in the output domains of the variables.

84. (New) A method according to claim 66, wherein receiving the set of variables comprises receiving variables that are characteristic of inputs to a system under test, and wherein reducing the input domains comprises determining values of the inputs to be made to the system based on the output domains of the variables.

85. (New) A method according to claim 84, wherein the system comprises an electronic processor, and wherein determining the values of the inputs comprises determining commands and addresses to be input to the processor.

86. (New) A method according to claim 66, wherein receiving the set of variables comprises receiving control parameters of a mechanical system, and

wherein reducing the input domains comprises generating a command to control the system based on the output domains of the parameters.

87. (New) A method according to claim 66, wherein receiving the set of variables comprises receiving features of an image containing visual information, and wherein reducing the input domains comprises identifying an object in the image based on the features.

88. (New) A method according to claim 66, wherein receiving the set of variables comprises receiving a natural language input, and wherein reducing the input comprises parsing the natural language, responsive to the output domains, so as to interpret the language.

89. (New) A method according to claim 66, wherein receiving the set of variables comprises receiving characteristics of a condition, and wherein reducing the input domains comprises determining a diagnosis of the condition based on the output domains.

90. (New) A method according to claim 66, wherein receiving the set of variables comprises receiving characteristics of resources whose use is to be scheduled, and wherein reducing the input domains comprises scheduling the use of the resources subject to the set of relations.

91. (New) A method according to claim 66, wherein at least one of the constraints comprises a relation among at least three of the variables.

92. (New) Apparatus for solving a constraint satisfaction problem, comprising a constraint processor, arranged to receive a set of variables having respective input domains and a set of constraints comprising one or more relations defined as a combination of operators, the combination comprising at least one operator selected from a group of arithmetic and bitwise operators, which are applied to the variables,

wherein the constraint processor is arranged to build a network of one or more hyper-arcs representative of the set of constraints, each hyper-arc corresponding to one of the relations expressed in terms of the operators and linking nodes in the network corresponding to the variables to which the operators are applied, and to reduce the input domains of the variables in the network responsive

to the operators, so as to determine respective output domains of the variables that are consistent with the set of constraints.

93. (New) Apparatus according to claim 92, wherein the constraints received by the processor are specified using a constraint-specification language having grammatical rules, and wherein the processor is arranged to build the network automatically based on the constraints specified in the language.

94. (New) Apparatus according to claim 92, wherein the processor is arranged to reduce the input domains by finding projections of the operators onto the domains of the variables.

95. (New) Apparatus according to claim 94, wherein the set of variables comprises an output variable and at least one input variable for each of the operators, and wherein the processor is arranged to project the domain of the at least one input variable of each of the operators onto the domain of the output variable thereof, and to project the domain of the output variable of each of the operators onto the domain of the at least one input variable thereof.

96. (New) Apparatus according to claim 92, wherein the operators comprise multi-variable operators, which receive two or more of the variables as their inputs.

97. (New) Apparatus according to claim 96, wherein the multi-variable operators comprise one or more operators selected from the group consisting of arithmetic addition, arithmetic subtraction, arithmetic multiplication, arithmetic division and modulo operators.

98. (New) Apparatus according to claim 96, wherein the multi-variable operators comprise one or more operators selected from the group consisting of an operator testing arithmetic equality of two of the variables, an operator testing arithmetic inequality of two of the variables, and an operator testing whether one of the variables is greater than another of the variables.

99. (New) Apparatus according to claim 96, wherein the multi-variable operators comprise one or more operators selected from a group consisting of a bitwise “and,” bitwise “or” and bitwise “exclusive or” operations.

100. (New) Apparatus according to claim 92, wherein the combination of operators further comprises at least one logical operator.

101. (New) Apparatus according to claim 100, wherein the at least one logical operator comprises at least one of a disjunction operator, a negation operator, and an implication operator.

102. (New) Apparatus according to claim 92, wherein the processor is arranged, for each of the hyper-arcs, to assemble the variables in a hierarchy based on the relation corresponding to the hyper-arc, and to reduce the input domains of the variables in the hierarchy, so as to determine the respective output domains of the variables that are consistent with the set of constraints.

103. (New) Apparatus according to claim 102, wherein the hierarchy of the variables comprises a hierarchical graph, having vertices corresponding to the variables.

104. (New) Apparatus according to claim 103, wherein the hierarchical graph has the form of one or more trees.

105. (New) Apparatus according to claim 104, wherein the processor is arranged to reduce the input domains over each of the trees so as to find respective interim domains of the variables that are consistent with the relation over each of the trees, and to combine the interim domains over all of the trees to determine the output domains.

106. (New) Apparatus according to claim 103, wherein the set of constraints is defined as a combination of operators, selected from a group of arithmetic, bitwise and logical operators, which are applied to the variables, and wherein the graph comprises vertices corresponding to the operators, connecting the vertices corresponding to the variables.

107. (New) Apparatus according to claim 92, wherein the set of constraints is represented as a disjunction of multiple relations, with one of the hyper-arcs corresponding respectively to each of the relations, and wherein the processor is arranged to determine interim domains of the variables for each of the hyper-arcs,

and to take a union of the interim domains for each of the variables to determine the output domains.

108. (New) Apparatus according to claim 92, wherein the processor is arranged to determine the output domains such that for any given value in the respective output domain of each of the variables, there exist values of the other variables in the respective output domains thereof that, together with the given value, constitute a solution to the set of constraints.

109. (New) Apparatus according to claim 92, wherein the processor is arranged to determine the output domains such that every set of values of the variables in the input domains that constitutes a solution to the set of constraints is contained in the output domains of the variables.

110. (New) Apparatus according to claim 92, wherein the set of constraints comprises a relation that relates to at least three of the variables.

111. (New) Apparatus according to claim 92, wherein the set of variables comprises variables that are characteristic of inputs to a system under test, and wherein the processor is arranged to determine values of the inputs to be made to the system based on the output domains of the variables.

112. (New) Apparatus according to claim 111, wherein the system comprises an electronic device, and wherein the inputs comprise commands and addresses to be input to the device.

113. (New) Apparatus according to claim 92, wherein the set of variables comprises control parameters of a mechanical system, and wherein the processor is arranged to generate a command to control the system based on the output domains of the parameters.

114. (New) Apparatus according to claim 92, wherein the set of variables comprises features of an image containing visual information, and wherein the processor is arranged to identify an object in the image based on the features, responsive to the output domains.

115. (New) Apparatus according to claim 92, wherein the set of variables comprises a natural language input, and wherein the processor is arranged to parse

the natural language, responsive to the output domains, so as to interpret the language.

116. (New) Apparatus according to claim 92, wherein the set of variables comprises characteristics of a condition, and wherein the processor is arranged to determine a diagnosis of the condition, based on the output domains.

117. (New) Apparatus according to claim 92, wherein the set of variables comprises characteristics of resources whose use is to be scheduled, and wherein the processor is arranged to schedule the use of the resources subject to the set of constraints, based on the output domains.

118. (New) A computer software product for solving a constraint satisfaction problem, the product comprising a computer-readable medium in which program instructions are stored, which instructions, when read by a computer, cause the computer, upon receiving a set of variables having respective input domains and a set of constraints comprising one or more relations defined as a combination of operators, the combination comprising at least one operator selected from a group of arithmetic and bitwise operators, which are applied to the variables, to build a network of one or more hyper-arcs representative of the set of constraints, each hyper-arc corresponding to one of the relations expressed in terms of the operators and linking nodes in the network corresponding to the variables to which the operators are applied, and to reduce the input domains of the variables in the network responsive to the operators, so as to determine respective output domains of the variables that are consistent with the set of constraints.